Upper Extremity Injuries in the Skeletally Immature Athlete

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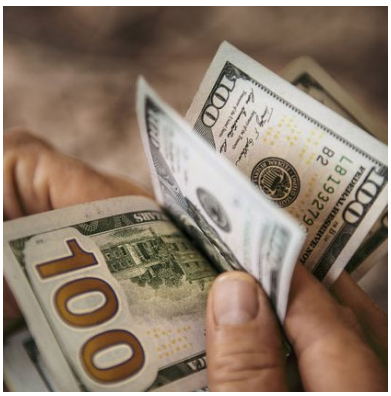
Financial Disclosure

I have no financial disclosures related to this talk



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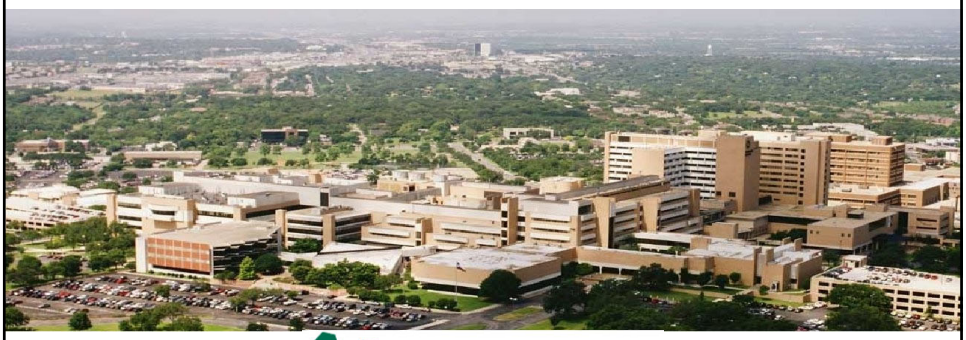
Who Am I?



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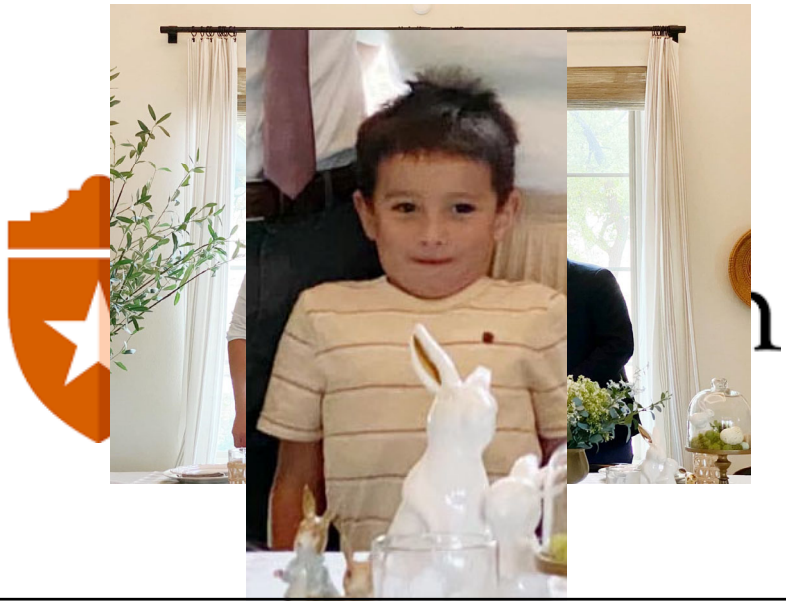

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Outline

Traumatic Injuries

- Principles of Physeal Growth
- Fractures/Dislocations

Overuse Injuries

- Shoulder and Elbow Injuries
- Injury Prevention

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Immature Skeleton

Plastic deformation

Open physes

Shorter healing times

Remodeling potential

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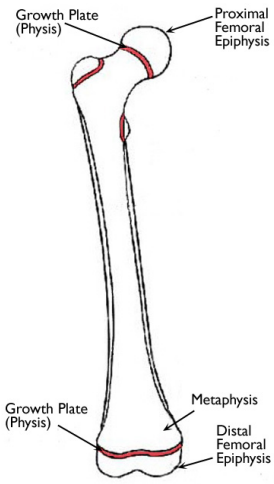
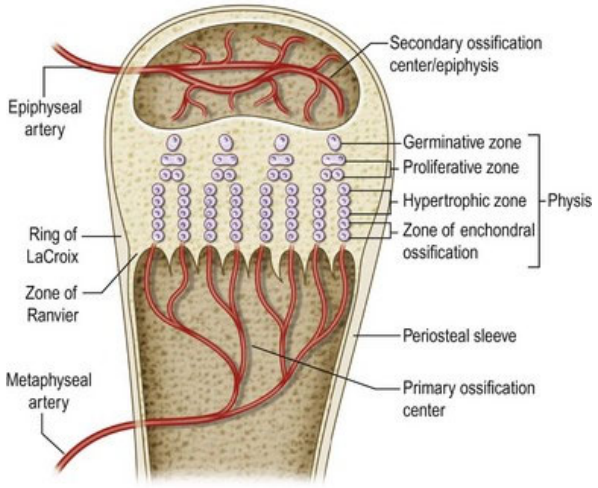
Principles of Physeal Growth





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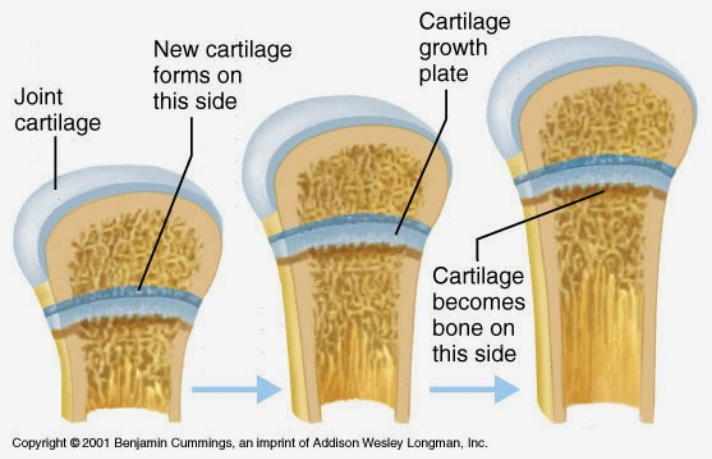
Principles of Physeal Growth



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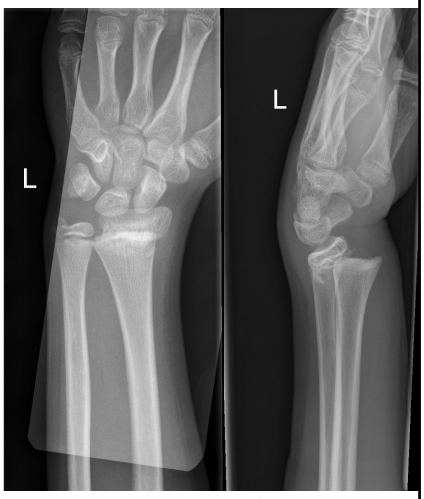
Physeal Fractures

Salter Harris 1-5

↑Growth arrest 1-5

↑Remodeling potential at active physes



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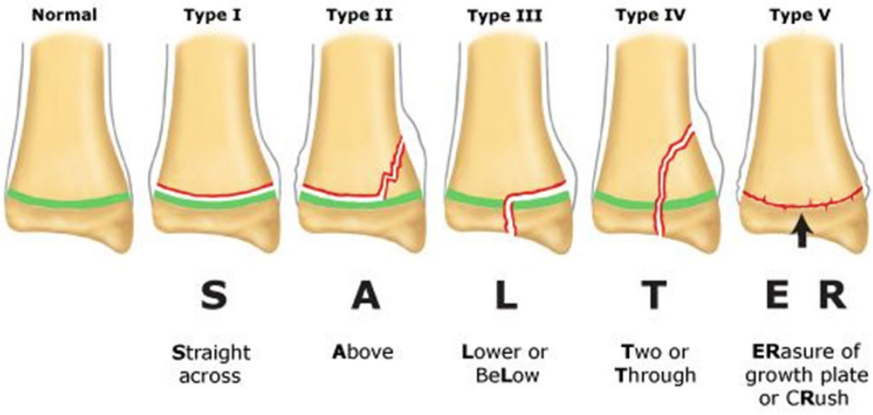
Physeal Fractures



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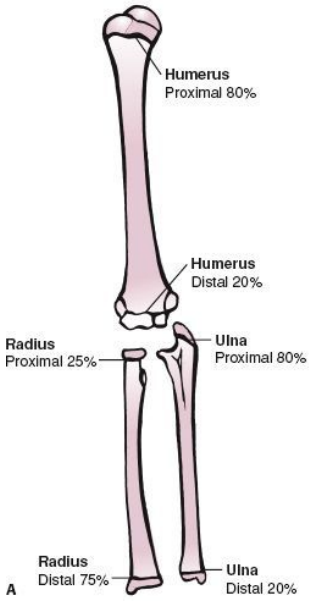
Physeal Growth

Humerus
- Proximal = 80%
- Distal = 20%

Forearm
- Proximal = ulna
- Distal = radius



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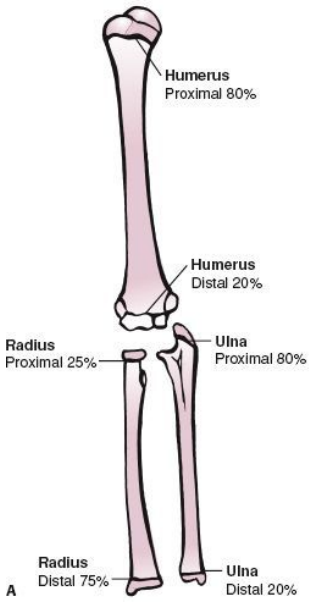
Physeal Growth

Less growth at ELBOW

Therefore cannot tolerate as much deformity at elbow



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Age at Skeletal Maturity

Girls – 14

Boys – 16

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Traumatic Injuries

Clavicle Fractures

Proximal Humerus Fractures

Supracondylar Humerus Fractures

Lateral Condyle Fractures

Medial Epicondyle Fractures

Elbow Dislocations

Shoulder Dislocations

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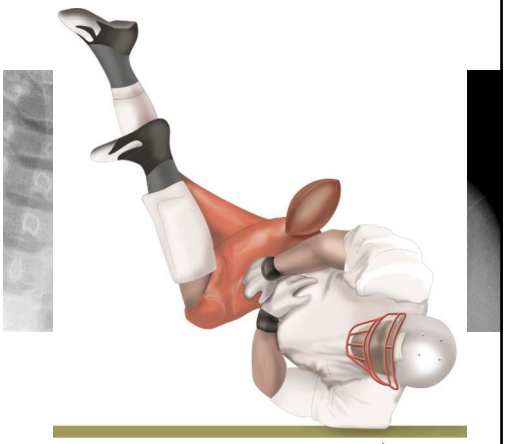
Clavicle Fractures

15% pediatric upper extremity injuries

Fall onto shoulder



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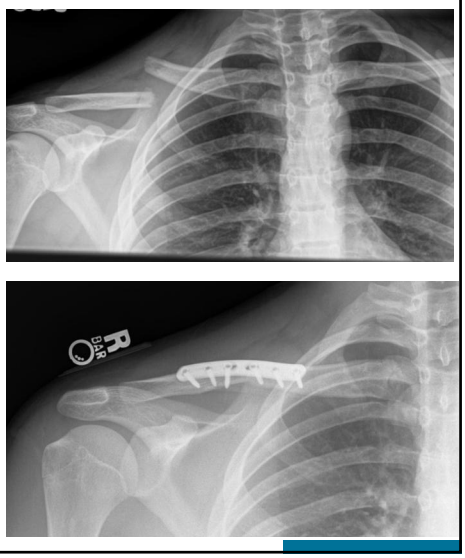
Clavicle Fractures

Most can be treated non-op
- sling with early ROM

ORIF reserved for
- Open fractures
- Skin/vessel compromise
- Athletes??



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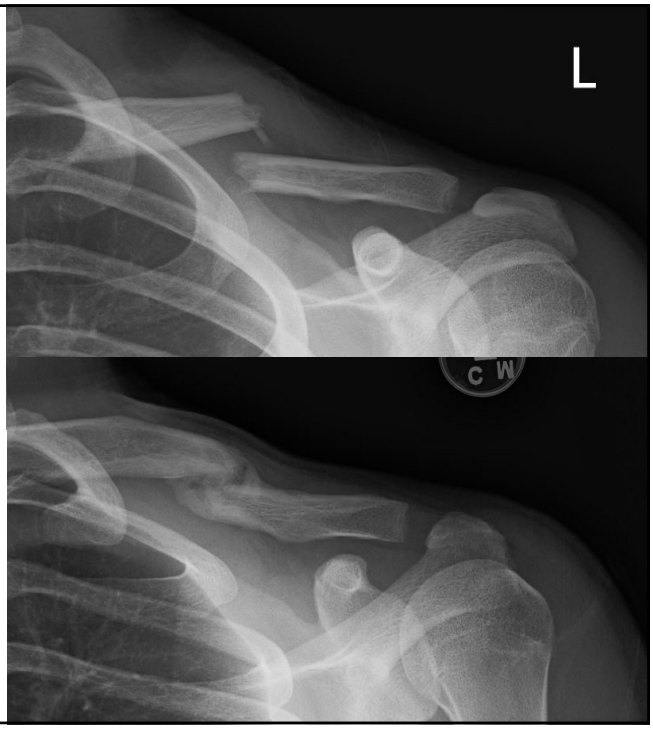
16yo

2mo



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Clavicle Fractures

Plate osteosynthesis of midshaft clavicle fractures in adolescent contact sports athletes - adolescent clavicle fracture

Saygin Kamaci[a,b], Laura Bess[a], Georgina Glogovac[a] and Angelo J. Colosimo[a]

Journal of Pediatric Orthopaedics B 2022, Vol 31 No 1

Table 2 Studies on surgical treatment of mid-shaft clavicle fractures on athletes

	Total number of athletes/ adolescent athletes	Age	RTS rate	RTS time (mean)	Indications	Outcome	Implant type/complications
Meisterling *et al.* [22]	29/not specified	19 (12–39)	100%	83 days (13–277 days)	Displaced/comminuted fracture, athlete request for faster RTS	Quick dash 0.8 (0–4.6)	Plate/1 superficial infection, 1 keloid formation, 1 implant removal, 1 transient paresthesia
Jubel *et al.* [17]	12 athletes/2	25 (13–45)	100%	6 days return to athletic activity, 17 days return to competition (10–26 days)	Displacement 2 cm	Constant score 98 (95–100)	Elastic stable intramedullary nail/no complication, all implants removed
Ranaletta *et al.* [34]	54/not specified	30 (16–60)	98%	68 days (5–180 days)	Displaced/comminuted fracture	Quick dash 0.4 (0–7.1)	Plate/1 extrinsic compression of the subclavian vein, 1 nonunion, and 1 implant loosening. Implant removal was necessary in 5 patients (9.3%).
Verborgt *et al.* [35]	39/not specified	28 (17–34)	100%	45 days (2–210 days)	Displaced fracture	Constant score 88 (50–98), 95% satisfied	Plate/wound infection 18%, refracture 5%, nonunion 5%, neurologic symptoms 7%
Our study	14/14	14 (12–16)	100%	46 days (24–70 days), return back to competition 63 days (24–90 days)	Displaced/comminuted fracture, angulated fracture with high impact/contact sports participation	NCS 92 (84–98)	Plate/prominent implant in 5 cases, 2/ 5 (14%) required implant removal

NCS, Nottingham clavicle score; RTS, return to sports.

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Clavicle Fractures

Advertisement End

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https://doi.org/10.1177/03635465221114420

SAGE journals

Article - Shoulder

Two-Year Functional Outcomes of Operative vs Nonoperative Treatment of Completely Displaced Midshaft Clavicle Fractures in Adolescents: Results From the Prospective Multicenter FACTS Study Group

Benton E. Heyworth, MD [1,*], Andrew T. Pennock, MD [2], Ying Li, MD[3], Elizabeth S. Liotta, MBBS, Brittany Dragonetti, MA[4], David Williams, PhD[5], Henry B. Ellis, MD[6], Jeffrey J. Nepple, MD[7], David Spence, MD[8], S. Clifton Willimon, MD, Crystal A. Perkins, MD[9], Nirav K. Pandya, MD[10], Mininder S. Kocher, MD, MPH[11], Eric W. Edmonds, MD[12], Philip L. Wilson, MD[13], Michael T. Busch, MD[14], Coleen S. Sabatini, MD[15], Frances Farley, MD[16], and Donald S. Bae, MD[17,18]

Conclusion: Surgery demonstrated no benefit in patient-reported quality of life, satisfaction, shoulder-specific function, or prevention of complications after completely displaced clavicle shaft fractures in adolescents at 2 years after injury.

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Proximal Humerus Fractures

Direct trauma

5-11 YO metaphyseal

> 11 YO Salter II

Tremendous remodeling potential

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Proximal Humerus Fractures

Sling followed by ROM

Fixation rarely needed

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Proximal Humerus Fractures

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Proximal Humerus Fractures

Is There a Role for Isolated Closed Reduction in the Emergency Department Without Fixation for Displaced Proximal Humerus Fractures in Adolescents?

Beltran Torres-Izquierdo, MD, Abhishek Tippabhatla, BS,* Keith Baldwin, MD, MPH,† Vidyadhar Upasani, MD,‡ Julia Sanders, MD,§ Rachel Goldstein, MD, MPH,‖ Jaime Rice Denning, MD, MS,¶ and Pooya Hosseinzadeh, MD**

J Pediatr Orthop • Volume 00, Number 00, ■■ 2023

Conclusions: For displaced PHFx treated nonoperatively, our data suggests INR has a similar radiographic and clinical outcome when compared with CR. Our results question the necessity of performing CR in this group of patients.

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Humeral Shaft Fractures

Rare

Many can be treated non-op

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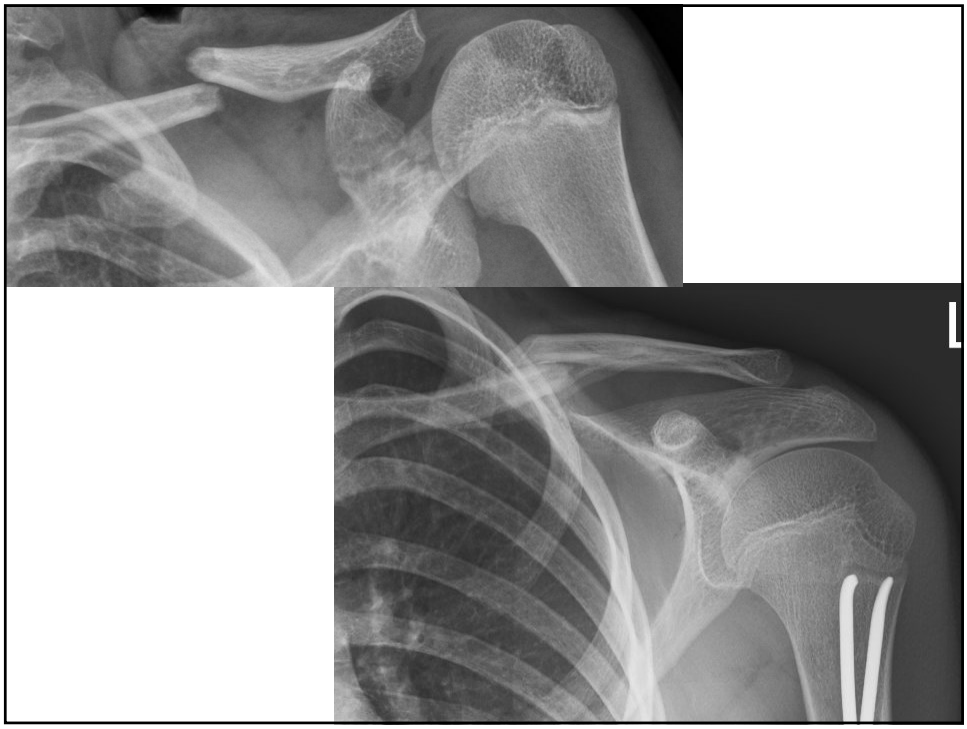
12yo M

28

12yo M

6 wks

29



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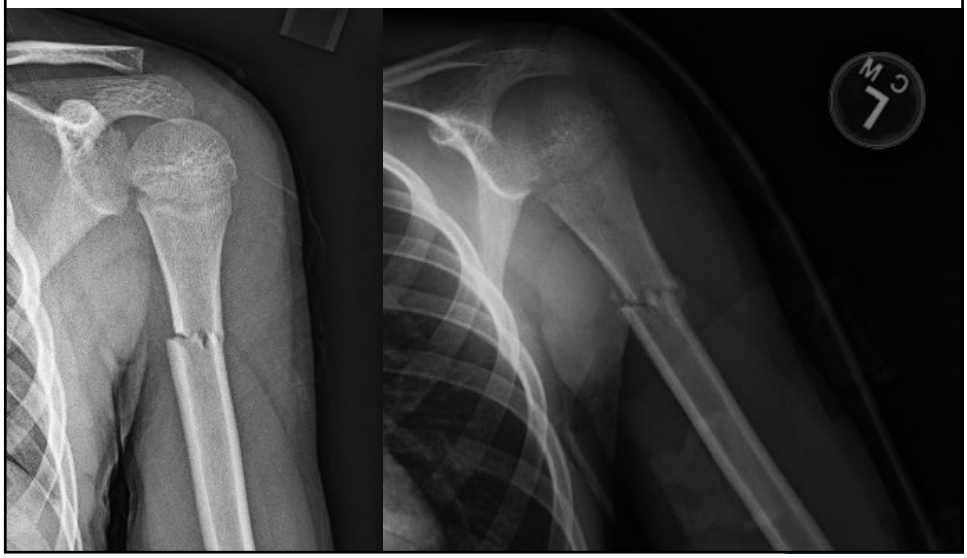
8yo M



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Supracondylar Humerus Fractures

50-70% of pediatric elbow fractures

Most frequent 3 - 10 years old (young athletes)

Extension (95-98%)

Neurologic injury 10-15%

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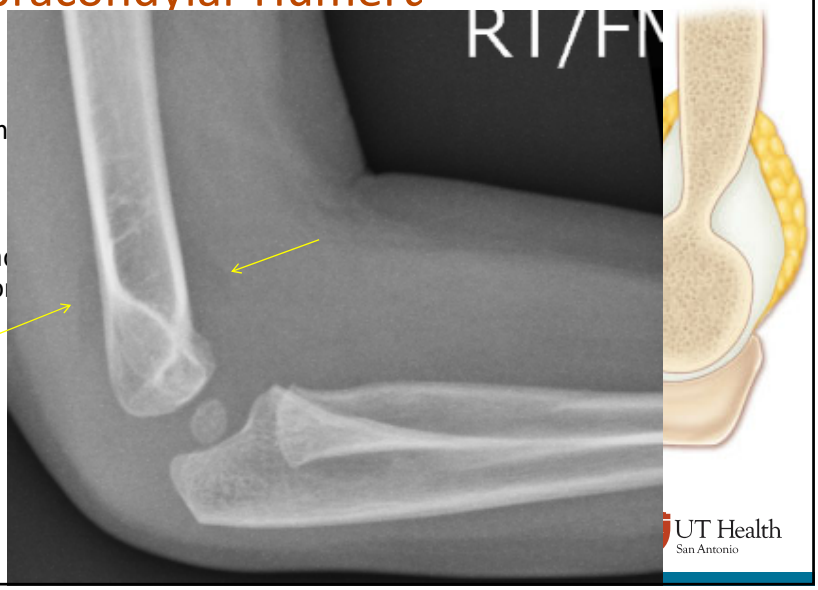
Supracondylar Humerus Fractures

Comm

Displa
fixatio



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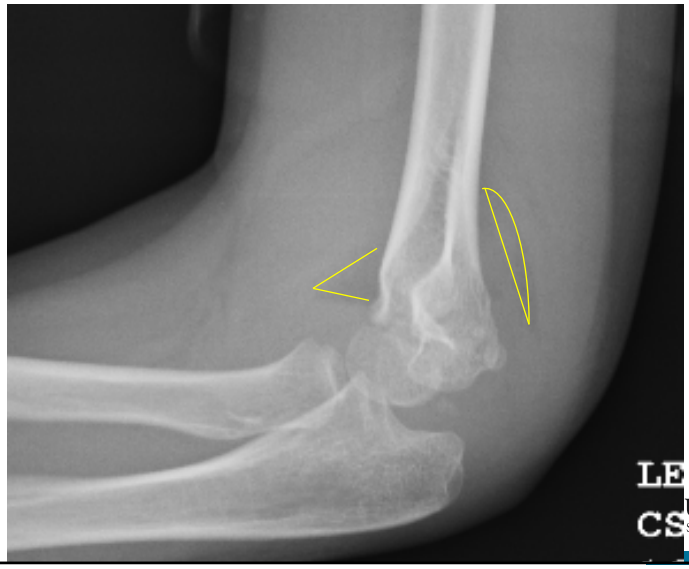
Supracondylar Humerus Fractures



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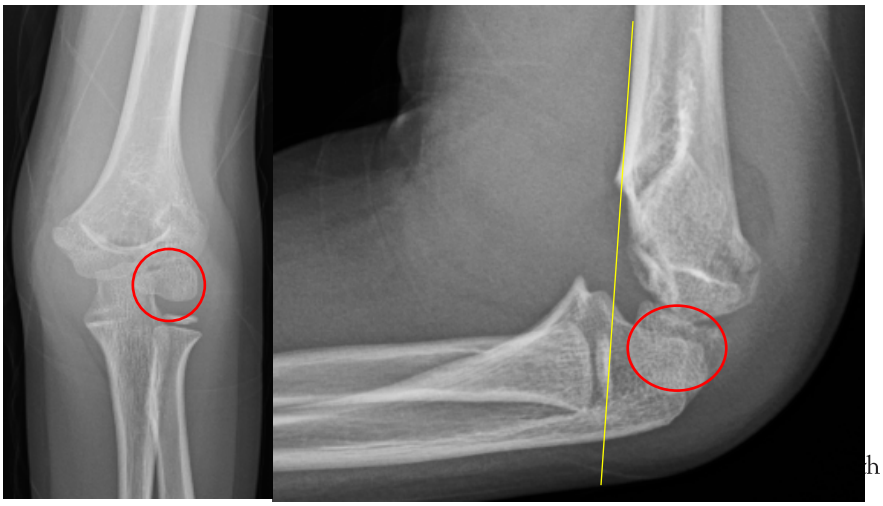
Supracondylar Humerus Fractures



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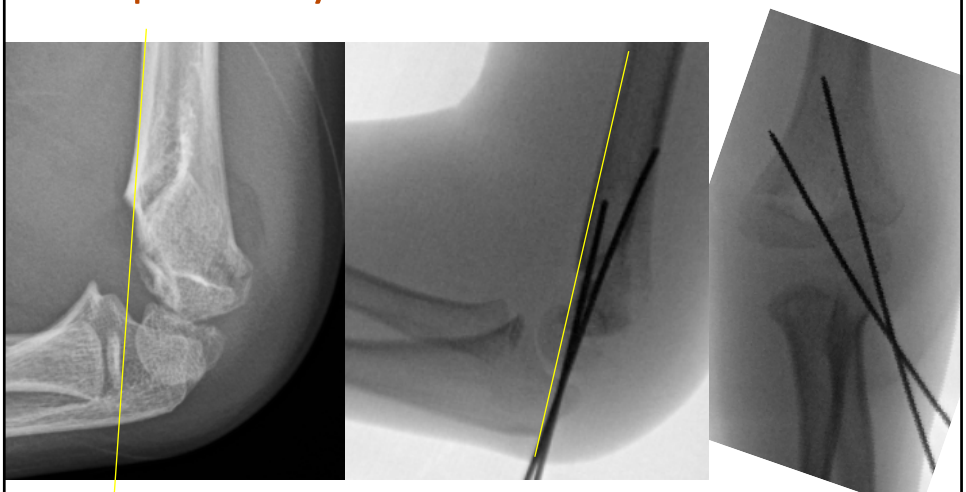
Supracondylar Humerus Fractures



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Lateral Condyle Fractures

Treat aggressively

Fixation if displaced

Heal slower

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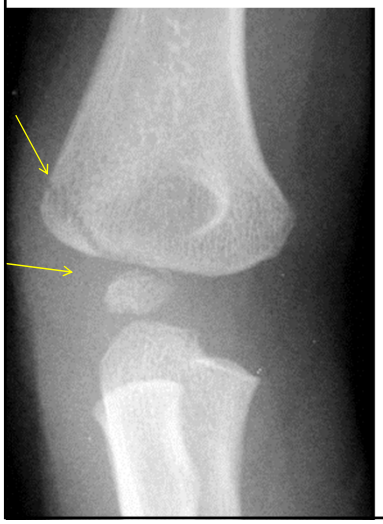
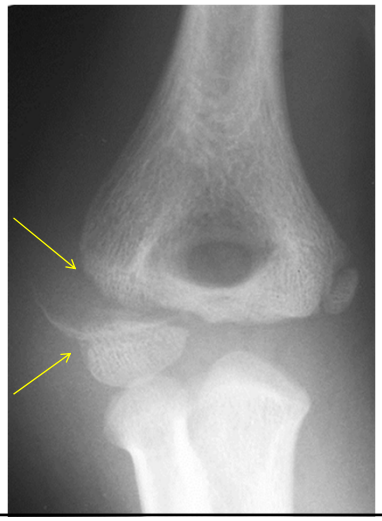
Lateral Condyle Fractures





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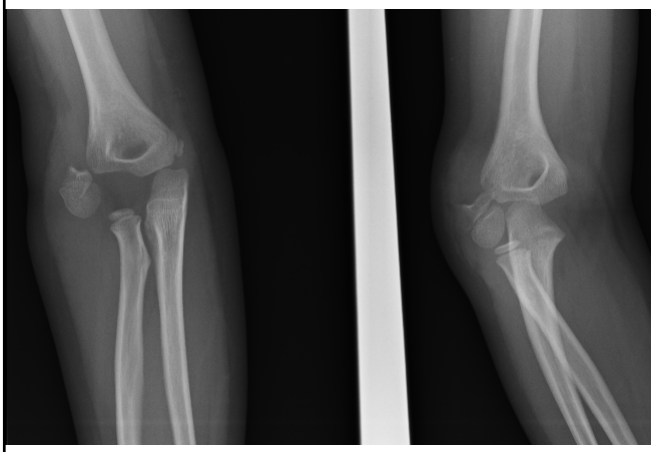
Lateral Condyle Fractures



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Lateral Condyle Fractures

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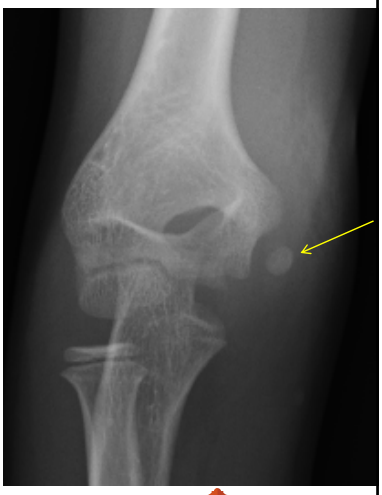
Medial Epicondyle Fractures

10% pediatric elbow fractures

50% associated with elbow dislocations

Avulsion injury in adolescents 10-14 years of age (common in dislocations)



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Medial Epicondyle Fractures

Classified by displacement
- I – Non-displaced
- II – ≤5 mm
- III – >5 mm

Treatment
- I – cast
- II or III – controversial

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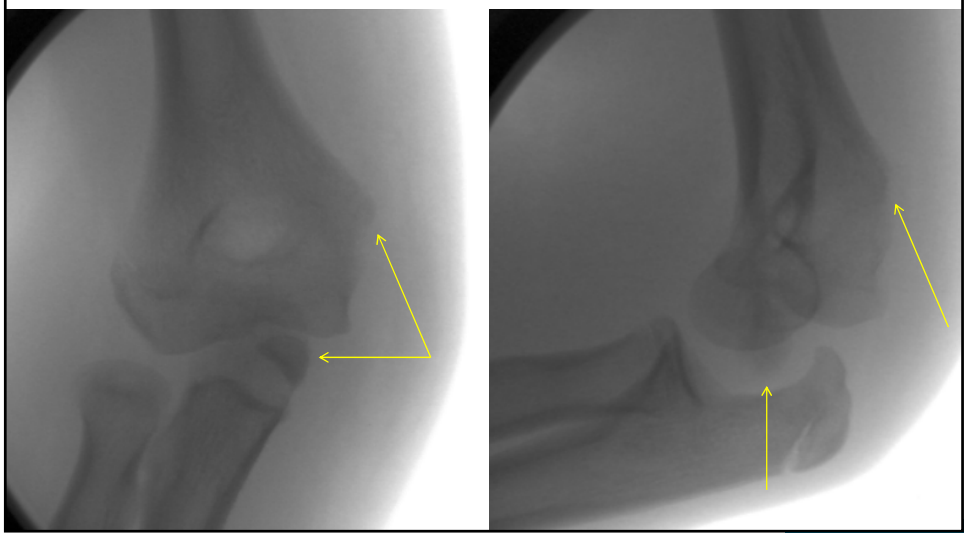
Medial Epicondyle Fractures



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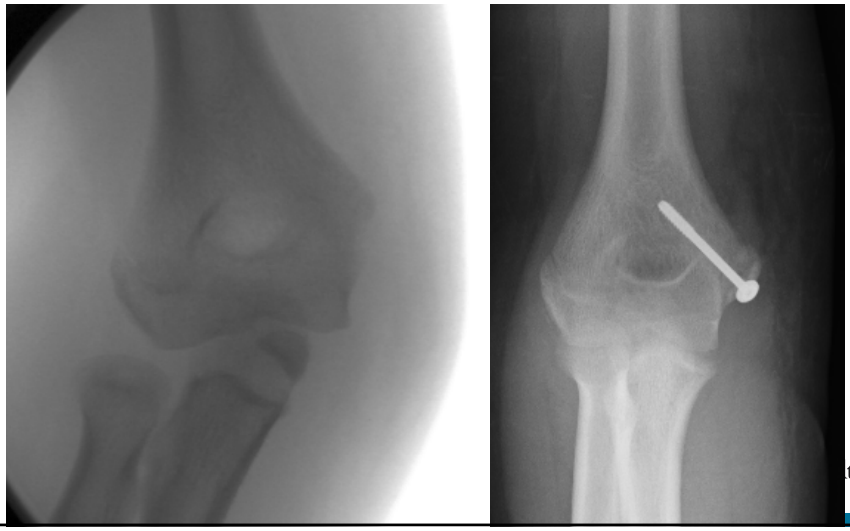
Medial Epicondyle Fractures



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Elbow Dislocation

80% have fracture

Average age 11

Splint and send to ER

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Elbow Dislocation

Treatment:

- No fracture – reduce and immobilize 3-4 weeks
- Fracture – reduce and ORIF fracture

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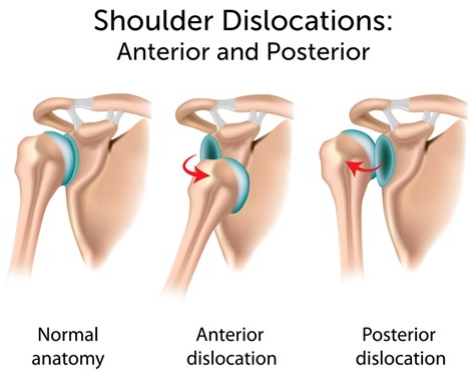
Shoulder Dislocation

Rare in patient's younger than 10yo

Soft tissues stronger than physis

More commonly fracture



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Shoulder Dislocation

Reduce in field??

Splint and send to ER

Could have associated fracture

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Overuse Injuries

Little League/Throwers Shoulder

Little League/Throwers Elbow

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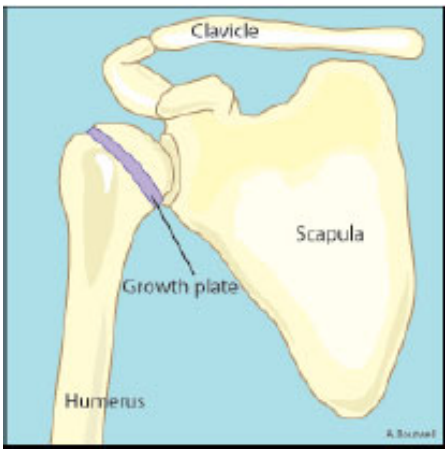
Thrower's/Little League Shoulder

Proximal humeral **epiphysiolysis**

Overuse injury with pain at the shoulder

Caused from overload on the proximal humeral growth plate (physis)



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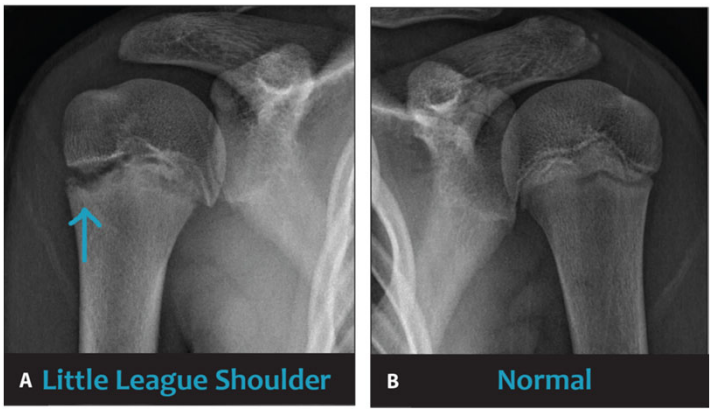
Thrower's/Little League Shoulder

Starts to separate (lysis) at the level of the growth plate



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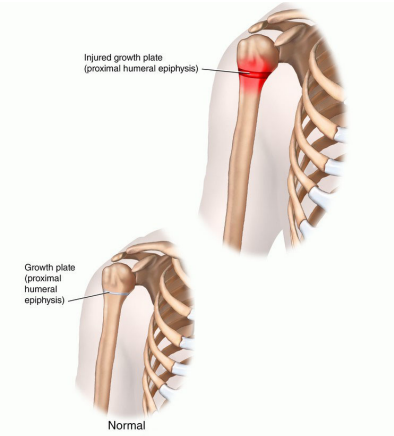
Thrower's/Little League Shoulder

Most common from 10-15yo

Pain that is worse with activity and improves with rest

Could start with an abrupt increase in pitch count or with throwing a "new" pitch

Also can be found in swimmers who increase their distance quickly



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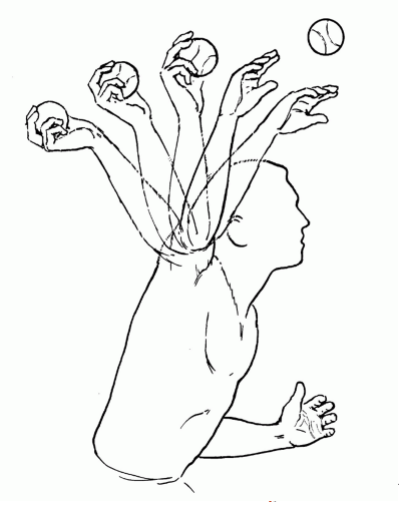
Thrower's/Little League Shoulder

Treatment = Rest

- Some authors suggest 3 months

No throwing during rest

- Start throwing rehab when XR normalized and completely pain free



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Little League Elbow

Similar presentation at a different joint

Valgus overload on the distal humerus

Causes irritation and widening of the medial epicondyle growth area.

Without rest can lead to medial epicondyle avulsion fractures

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Prevention of Injuries

Proper throwing mechanics

Discourage curve balls until high school (puberty)

Ban the radar gun in youth sports

Mandate a 3 month "rest-period" each year for throwing athletes

Pitch Counts and rest based on age and skeletal maturity

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Little League Baseball Pitch Count Regulations

Age	Limits Per Game	Rest Requirements
17-18 years	105/day	76 or more pitches → 4 days rest 61-75 pitches → 3 days rest 46-60 pitches → 2 days rest 31-45 pitches → 1 day rest 01-20 pitches → 0 days rest
15-16 years	95/day	
13-14 years	95/day	66 or more pitches → 4 days rest 51-65 pitches → 3 days rest 36-50 pitches → 2 days rest 21-35 pitches → 1 day rest 01-20 pitchers → 0 days rest
11-12 years	85/day	
9-10 years	75/day	
7-8 years	50/day	

From The Little League® Pitch Count Regulation Guide for Parents, Coaches and League Officials; with permission.

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Prevention of Injuries

BASEBALL INJURIES

Injuries in young athletes are on the rise, but elbow and shoulder injuries in children are on the verge of becoming an epidemic. Thousands of children are seen each year complaining of elbow or shoulder pain. Damage or tear to the ulnar collateral ligament (UCL) is the most common injury suffered and is often caused by pitchers throwing too much. This ligament is the main stabilizer of the elbow for the motions of pitching. When it becomes damaged, it can be difficult to repair and rehabilitate.

Rest Periods Required

Ages 7–16	*Ages 17–18*	*Required # of Rest Pitches*
61+	76+	3 calendar days
41–60	51–75	2 calendar days
21–40	26–50	1 calendar day
1–20	1–25	None

Maximum Pitch Counts

Age	*Pitches/Game*
7–8	50
9–10	75
11–12	85
13–16	95
17–18	105

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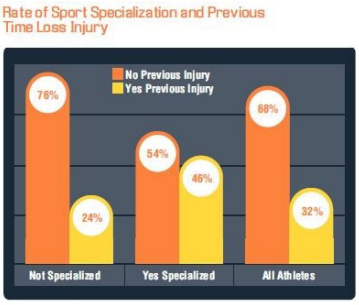
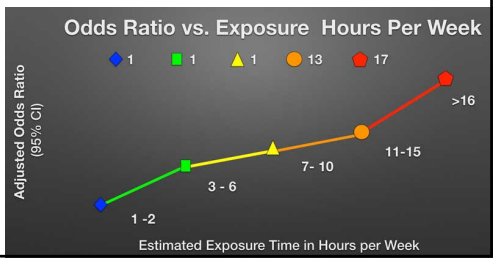
Prevention of Injuries

Specialized athletes 2x more likely to sustain a repetitive-use injury

Specialized athletes have 2.25 greater odds of having a serious overuse injury

Specialized athletes have increased rates of psychological burnout





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Thank You

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